AD-A105 983 ARMY ENGINEER DISTRICT ST LOUIS MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. SNOW HOLLOW DAM (MO 30337). MISSIS--ETC(U)
SEP 78 R J DIECKMANN, K ALEXANDER

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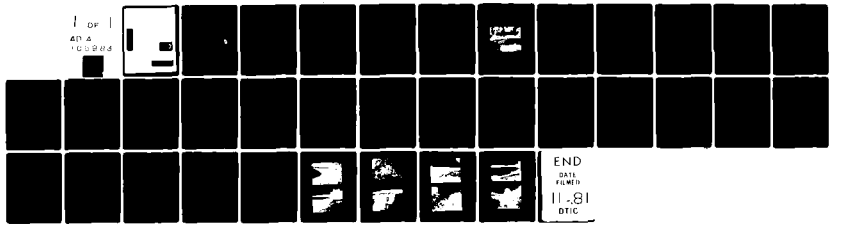

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SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	

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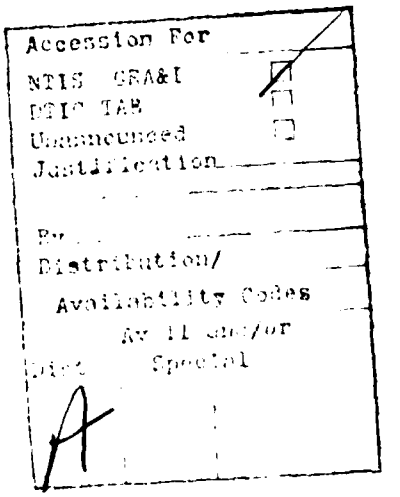
LOWER MISSISSIPPI RIVER BASIN

SNOW HOLLOW DAM
IRON COUNTY, MISSOURI

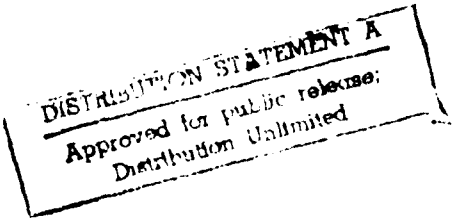
MISSOURI INVENTORY NO. 30337

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

SEPTEMBER 1978



Phase I Report
National Dam Safety Program

NAME: Snow Hollow (Mo. 30337)
LOCATION: Iron County, Missouri
STREAM:
DATE OF INSPECTION: 14 September 1978

Snow Hollow Dam (Mo. 30337) was inspected by an interdisciplinary team of engineers from the St. Louis District, U.S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, to determine if the dam poses hazards to human life or property. The inspection and assessment were made using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U.S. Army, Washington D.C., with the help of Federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The downstream damage zone for this dam is approximately 5 miles long. Four houses and farm buildings would be subjected to flooding with possible damage and/or destruction and possible loss of life. The dam is in the small size classification because it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

For its size and hazard category, this dam is required to pass from one-half the Probable Maximum Flood (PMF) to the PMF. The PMF is defined as the flood discharge resulting from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Considering the small volume of water impounded, the large floodplain downstream, and the four houses and farm buildings downstream, one-half PMF is the appropriate spillway design flood. Since the spillway of this dam will pass only 40 percent of the PMF without overtopping the dam, it is classified as seriously inadequate. Our evaluation indicates that the spillways will pass the 100-year flood, that is a flood having a 1 percent chance of exceedence in any given year.

Deficiencies observed by the inspection team were heavy brush and trees up to 3 inches in diameter growing on the downstream slope of the dam, seepage at the downstream toe near the center of the dam and lack of erosion protection on the upstream slope of the dam and on the northeast side of the spillway exit channel.

The earthen sections adjacent to the rock spillways do not appear sufficiently resistant to prevent embankment erosion at high flows for an indefinite time. Seepage and stability analyses comparable to the requirements of the guidelines are not on record, which is considered a deficiency and should be rectified.

It is recommended that action be taken by the owner to correct the deficiencies listed herein in the near future. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design of dams. These conclusions were reached by the undersigned inspection team members.

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RON DIECKMANN
Hydraulic Engineer

Ken Alexander
KEN ALEXANDER
Soils Engineer

Michael M. Easterly
MIKE EASTERLY
Geologist

SUBMITTED BY: Chief, Engineering Division — 2 Nov 78 Date

APPROVED BY: Colonel, CE, District Engineer — 3 Nov 78 Date

OVERVIEW OF SNOW HOLLOW LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SNOW HOLLOW DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SNOW HOLLOW DAM ID NO. 30337

Section 1 - Project Information

1.1 GENERAL.

a. Authority: The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Snow Hollow Dam be made.

b. Purpose of Inspection: The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria: The inspection was accomplished using the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U.S. Army, Washington D.C., with the help of several Federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

1.2 DESCRIPTION OF PROJECT.

a. Description of Dam and Appurtenances: The dam is an earthfill dam with two spillways cut into the rock formations on the right and left abutments (see PHOTOS 1 and 2). The right spillway is the primary overflow exit channel. The left spillway is not as deep as the right spillway and is considered an emergency overflow channel. The lake is formed by five springs which produce flows reported to be 25,000 gallons per day. A primary portion of the drainage area for this lake is heavily wooded except for approximately 100 acres on the north and east sides of the lake which have been subdivided into lots with approximately 40 homes and cabins occupied on a full or part-time basis.

b. Location: The dam is located in the northeast portion of Iron County, Missouri. The general location of Snow Hollow Dam and the hilly topography in the vicinity of the lake are shown on PLATE 1. The lake is shown on the Graniteville, Missouri, quadrangle sheet in Sections 26 and 27, Township 34 north, Range 3 east of the fifth principal meridian.

c. Size Classification: Small

d. Hazard Classification: High

e. Ownership: Valley Enterprises
Box 107
Ironton, Missouri 63650

f. Purpose of Dam: Recreation

g. Design and Construction History: The dam was constructed 21 years ago (1957+) for the present owner. The dam was constructed with clay obtained from a field upstream of the dam. The dam foundation was constructed by excavating a 20-foot wide core trench down to bedrock. This core trench was filled with clay and compacted with sheepsfoot rollers. The initial upstream and downstream faces of the dam were 1V on 2-1/2H, but soon after construction slides began to occur on the downstream slope and localized seepage was observed near the toe of the dam. The seepage and slides were controlled with rock placed on the downstream toe of the dam. Approximately 90 cubic yards of soft mucky embankment material were removed from the downstream toe at the seep and replaced with rock. An additional 1,000 cubic yards ± were placed on the lower one-third of the downstream slope to prevent additional slides. No increase in seepage or additional sliding has been noted since placement of the above rock.

h. Normal Operating Procedure: No operating records exist. Outflow passes over the primary uncontrolled spillway.

1.3 PERTINENT DATA.

a. Drainage Area: 481 acres

b. Discharge at Damsite: Not known

Maximum known flood at damsite - 3-foot depth over spillway reported

Primary spillway capacity at maximum pool elevation - 847 cfs; emergency spillway capacity at maximum pool elevation - 558 cfs

c. Elevation (feet above m.s.l. from assumed pool elevation 1278 noted on USGS quadrangle sheet (Graniteville, Mo.):

Top of dam - 1283.4

Maximum pool - 1283.4

Recreation pool - 1278.0

Streambed - 1244±

Maximum tailwater - Not known

d. Reservoir:

Length of maximum pool - Approximately 1,800 feet

Length of recreation pool - Approximately 1,700 feet

e. Storage (Acre-feet):

Recreation pool - 324

Flood control pool - 520

Top of dam - 520

f. Reservoir Surface (Acres):

Top of dam - 41.8

Maximum pool - 41.8

Flood control pool - 41.8

Recreation pool - 31.4

Spillway crest - 31.4

g. Dam:

Type - Earthfill

Length - 530 feet

Height - 35± feet

Top width - 17 feet

Side Slopes - Varies, typically 1 vertical on 3± horizontal downstream; upstream side slope could not be determined. A typical section is shown on PLATE 2.

Zoning - Not known

Impervious Core - Dam is apparently constructed of relatively impervious clay.

Cutoff - Reportedly a 20-foot wide clay cutoff to bedrock.

Grout curtain - None

h. Diversion and Regulating Tunnel: None

i. Spillways (cut out of natural rock formations):

Type - Primary - V-shape spillway
Emergency - Similar to a broad crested weir

Length of weir - Primary - 30-foot top width at 1283.4 feet msl
Emergency - 50 feet

Crest elevation - Primary - 1278
Emergency - 1281

Gates - None

j. Regulating Outlets: None

Section 2 - Engineering Data

2.1 DESIGN.

No design drawings or computations were available.

2.2 CONSTRUCTION.

The dam was reportedly constructed 21 years ago (1957±) for the present owners by the Mel Means Construction Company, formerly of Potosi, Missouri. The dam was constructed using borrow material from the lake area placed in lifts and compacted using a sheepsfoot compactor and by tracking with a dozer. The dam foundation was reportedly stripped to bedrock for a 20-foot width prior to placing the embankment material.

2.3 OPERATION.

No operating records exist. Outflow passes over the primary uncontrolled spillway.

2.4 EVALUATION.

a. Availability: The only available engineering data are the personal recollections of Mr. Mack Ringo, part owner.

b. Adequacy: The field surveys and visual inspections presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. These analyses should appropriately consider and evaluate the seepage conditions discussed in paragraph 3.1b(2).

c. Validity: Not applicable.

Section 3 - Visual Inspection

3.1 FINDINGS.

a. General: A visual inspection of the dam, spillways, and downstream channel was made on 14 September 1978 by Corps of Engineers, St. Louis District, personnel. Information provided by an owner relating to construction of the dam has been previously discussed in paragraph 1.2g. According to a part owner of the dam, there have been no overtopping problems since the dam was built and the downstream slope stability problems which occurred shortly after the dam was built have been solved by placing rock on the downstream face of the dam.

b. Project Geology:

(1) Snow Hollow Lake is located in an area underlain chiefly by highly resistant Precambrian volcanic rocks which form prominent knobs and ridges. Large-scale granite intrusions occur in the surrounding region, along with faulting and tabular basic intrusions. The Precambrian prominences are overlapped by lower Paleozoic sedimentary rocks at lesser elevations.

(2) The valley containing the lake is recessed in the flank of an irregular ridge composed of a volcanic unit known as the Stout's Creek Rhyolite. Outcrops of this formation were observed intermittently around the rim of the reservoir, in the spillway and on the downstream sides of the abutments. Overburden varies from 0-20 feet thick, the thicker zones containing large amounts of talus. The exposed bedrock consists of a brownish pink welded tuff containing fine to medium quartzitic and basic vitreous particles in an aphanitic groundmass.

(3) The exposed rock is moderately to highly jointed. Three major joint sets are apparent: N80°E, N20°E, and N20°W. The dip of the joints ranges from 30° to near vertical. No weathering was observed on the joints. In many cases, large pools of standing water were observed straddling several intersecting joints, indicating low permeability of the jointed rock.

(4) No sinks, caves, or springs were seen near the reservoir area, although residents report several underneath the lake.

(5) Due to the highly resistant nature of the volcanic rock underlying the reservoir, rapid erosion or solutioning and subsequent catastrophic bedrock collapse is not likely, although leakage may occur along joints.

c. Dam:

(1) No detrimental cracking or settlement was observed.

(2) Some seepage was observed at the downstream toe of the dam (see PHOTO 3). Due to the heavy vegetation on the downstream slope, it was difficult to estimate the seepage quantity. Seepage that could be seen appeared to have a flow of 1 gpm or less. Some of the seepage had a reddish color which indicates flow through a high iron content environment.

(3) It was reported by one of the owners that the dam has an iron pipe passing through the bottom with several concrete collars and an upstream gate. Neither the pipe nor the gate were visible. The gate was reported to be closed and unaccessable.

(4) Above the waterline, upstream slopes had no riprap protection and were quite steep (see PLATE 2 and PHOTO 4). Below the waterline, slopes appeared to be much flatter and were covered with rock and/or gravel.

(5) Trees up to 3 inches in diameter were growing on the lower downstream slope (see PHOTO 5).

d. Appurtenant Structures: Appurtenant structures of the dam consist of two spillways cut down to bedrock on the right and left abutments of the dam. The primary spillway is notched into the southwest (right) abutment (see PLATE 2). The northeast (inside) wall of this spillway exit channel has been excavated into the overburden and has almost a vertical slope with no riprap protection visible (see PHOTO 6).

e. Reservoir Area: The shoreline around the lake is gently sloping and no excessive erosion was observed. Many rock outcroppings which appear to be grey granite could be seen along the shoreline (see PHOTOS 7 and 8).

f. Downstream Channel: The downstream channel is covered with heavy vegetation and debris which has accumulated from dead trees and leaves. Heavy rock outcroppings also line the channel.

3.2 EVALUATION.

None of the conditions observed are significant enough to indicate a potential of failure or a need for immediate remedial action. However, special attention should be given to the seepage areas noted in paragraph 3.1b above. Trees and brush on the dam is a deficiency which should be corrected.

Provision of graded riprap on the upstream face of the dam is considered good engineering practice; however, the absence of existing wave erosion indicates the lack of riprap at this location is not of concern.

Section 4 - Operational Procedures

4.1 PROCEDURES.

Operational procedures are essentially nonexistent since the dam has uncontrolled spillways.

4.2 MAINTENANCE OF DAM.

Near the crest of the dam, brush has been cut on a regular basis. However, as discussed in Section 3, brush and trees on the lower downstream slope indicate a maintenance deficiency.

4.3 MAINTENANCE OF OPERATING FACILITIES.

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT.

No warning system is known to exist.

4.5 EVALUATION.

Additional maintenance in the form of clearing and mowing the embankments and establishing turf is recommended.

Section 5 - Hydraulic/Hydrologic

5.1 EVALUATION OF FEATURES.

a. Design Data: No design data were made available to the inspection team. All releases are non-regulated.

b. Experience Data: The drainage area and lake surface area were developed by planimetering a USGS quadrangle sheet. Surface area-elevation curves were determined by planimetering various contour lines within the drainage area on the USGS quadrangle sheets.

c. Visual Observations: The primary spillway in the right abutment consists of a natural cut in the rock outcropping. The top width of the spillway is approximately 30 feet. The emergency spillway is in the left abutment and its crest is 3 feet higher than the main spillway.

d. Overtopping Potential: The primary and emergency spillways for Snow Hollow Lake have been found inadequate to pass the Probable Maximum Flood (PMF) and one-half the PMF. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The primary and emergency spillways will pass approximately 40 percent of the PMF without overtopping. Routing 50 percent of the PMF through the lake will overtop the dam by .73 foot for .8 hour with a discharge of 2,557 cfs. The PMF would result in overtopping flow of approximately 7,093 cfs at a depth of about 2.51 feet for a duration of 3.3 hours. The primary and emergency spillways for Snow Hollow will pass the 100-year flood, which is a flood having a 1 percent chance of exceedance in any given year.

The spillway for Snow Hollow Dam is not capable of passing a minimum of one-half (50 percent) of the PMF without overtopping the dam and, therefore, is considered seriously inadequate.

The effect from rupture of the dam could extend approximately 5 miles downstream of the dam. There are four houses and several farm buildings located within 2 miles downstream.

Section 6 - Structural Stability

6.1 EVALUATION OF STRUCTURAL STABILITY.

a. Visual Observations: Visual observations of the dam and spillway are discussed and evaluated in Sections 3 and 5. The dam has no other appurtenant structures.

b. Design and Construction Data: As discussed in Section 2, no significant design data are available. Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. Construction data are based on the personal recollections of the owner.

c. Operating Records: No operating records are available.

d. Post-Construction Changes: Other than the addition of rock as discussed in paragraph 1.2g, no post-construction changes have occurred.

e. Seismic Stability: The dam is located in Seismic Zone 2, for which the inspection guidelines assign a "moderate" damage probability. Since neither original design analyses nor strengths of construction materials are available, an accurate seismic analysis cannot be made. The low dam height and clayey materials in the dam are factors minimizing the likelihood of failure due to an earthquake.

Section 7 - Assessment/Remedial Measures

7.1 DAM ASSESSMENT.

a. Safety: This dam has no available stability or seepage analysis. To assure that conventional stability safety factors comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' exist, stability analyses should be made. Although seepage observed downstream did not show any signs of piping material, uncontrolled seepage can quickly lead to a failure. Seepage analyses should be made and used to determine the need for and methods of controlling or eliminating this seepage. Noted below are other deficiencies which, if left uncontrolled, could cause unsafe conditions:

(1) Steep unprotected slopes above the waterline on the upstream face of the dam and on the inside (northeast) wall of the right spillway exit channel.

(2) Trees and heavy brush on the downstream slope.

(3) Inadequate spillway capacity.

b. Adequacy of Information: No details are available regarding design of the dam. Data from the visual observations and verbal discussions are considered adequate to support the conclusions herein. Seepage and stability analyses comparable to the requirements of the 'Recommended Guidelines for Safety Inspection of Dams' are not on record, which is considered a deficiency.

c. Urgency: It is recommended that the remedial measures listed in Section 7.2 be accomplished in the near future. The item recommended in paragraph 7.2c should be pursued on a high-priority basis.

d. Necessity for Phase II: No Phase II inspection is recommended.

7.2 REMEDIAL MEASURES.

The following remedial measures are recommended:

a. Remove trees and cut brush from the downstream slope. Holes created by the removal of tree roots should be suitably backfilled.

b. Provide erosion protection for the upstream slope above the waterline and on the inside (northeast) wall of the right spillway exit channel.

c. Spillway size and/or height of dam should be increased to pass a minimum of one-half of the PMF without overtopping the dam. In either case, the spillway should be protected to prevent erosion.

d. Stability and seepage analyses of the dam should be performed by a professional engineer experienced in the design and construction of dams. Special attention should be given to the area where seepage was observed. These analyses should provide a design of seepage control works and other remedial measures related to embankment stability and erosion protection which may be found necessary as a result of these analyses.

e. A detailed inspection of the dam and spillway should be made every 2 to 5 years by a professional engineer experienced in the design and construction of dams.

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 24-hour storm duration is assumed with total depth distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillways, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillways, and top of dam are defined by elevation-discharge curves.

3. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

4. The above analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. The inflow hydrograph was routed through the reservoir using HEC-1's modified puls option. Releases were calculated for: (1) the V-shaped primary spillway cut out of the natural rock formation, and (2) the dam and the emergency spillway not including the primary spillway.

Flow over the emergency spillway and dam was calculated using the broad-crested weir flow equation:

$$Q = CLH^{1.5}$$

where: C = 3.0

L = Length in feet (varies with water surface)

H = Head of water in feet (varies with water surface)

Q = Discharge in cfs

Flow over the V-shaped primary spillway was calculated using the equation $Q = CZH^{5/2}$ taken from the Handbook of Hydraulics by King and Brater, page 5-14,

where: C = 2.5

Z = 5 (side-slope of the V-shape, $Z = \tan \frac{\phi}{2}$

H = Head of water in feet (varies with water surface)

Q = Discharge in cfs

```
P *

A1   SNOW HOLLOW LAKE
A2   IRON COUNTY,MISSOURI
A3   DAM INVENTORY NO. 30337
B     300                  5                                                  -4
B1      5
J       1        6        1
J1    .1       .2       .3       .4       .5      1.0
K       0        1                                 3        1
K1   SUB-AREA COMPUTATION
M       1        2      .75                        1                          1
P              26.5      102      120      130
T                                                          -1      -84
W2              .13
X       5      -.1      2.0
K       1        2                          2        2        1
K1   ROUTE THROUGH LAKE
Y                                  1        1
Y1      1                                                -1278       -1
Y4   1278     1280     1281     1282     1283   1283.4     1284     1285     1286     1287
Y5      0       71      195      460     1081     1405     2350     3978     7416    11539
$S      0       68      501     1067
$E   1278     1280     1290     1300
$$   1278
$D1283.4
K      99
A
A
A
A
A
EOI.
E>Q
C>
```

949. 18. 1537. 657. 301. 137. 62. 28. 14. 3.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	5.	1.01	12.35	151	.23	.21	.01	1234.
1.01	.10	2	.01	0.00	.01	4.	1.01	12.40	152	.23	.22	.01	1242.
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1.01	.25	5	.01	0.00	.01	4.	1.01	12.55	155	.23	.22	.01	1253.
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1.01	1.05	13	.01	0.00	.01	2.	1.01	13.35	163	.27	.26	.01	1523.
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1.01	1.20	16	.01	0.00	.01	2.	1.01	13.50	166	.27	.26	.01	1531.
1.01	1.25	17	.01	0.00	.01	2.	1.01	13.55	167	.27	.26	.01	1532.
1.01	1.30	18	.01	0.00	.01	1.	1.01	14.00	168	.27	.26	.01	1534.
1.01	1.35	19	.01	0.00	.01	1.	1.01	14.05	169	.34	.33	.01	1598.
1.01	1.40	20	.01	0.00	.01	1.	1.01	14.10	170	.34	.33	.01	1740.
1.01	1.45	21	.01	0.00	.01	1.	1.01	14.15	171	.34	.33	.01	1843.
1.01	1.50	22	.01	0.00	.01	1.	1.01	14.20	172	.34	.33	.01	1888.
1.01	1.55	23	.01	0.00	.01	1.	1.01	14.25	173	.34	.33	.01	1910.
1.01	2.00	24	.01	0.00	.01	1.	1.01	14.30	174	.34	.33	.01	1921.
1.01	2.05	25	.01	0.00	.01	1.	1.01	14.35	175	.34	.33	.01	1926.
1.01	2.10	26	.01	.00	.01	1.	1.01	14.40	176	.34	.33	.00	1930.
1.01	2.15	27	.01	.00	.01	1.	1.01	14.45	177	.34	.33	.00	1932.
1.01	2.20	28	.01	.00	.01	1.	1.01	14.50	178	.34	.33	.00	1935.
1.01	2.25	29	.01	.00	.01	2.	1.01	14.55	179	.34	.33	.00	1934.
1.01	2.30	30	.01	.00	.01	3.	1.01	15.00	180	.34	.33	.00	1936.
1.01	2.35	31	.01	.00	.01	4.	1.01	15.05	181	.21	.20	.00	1812.
1.01	2.40	32	.01	.00	.01	6.	1.01	15.10	182	.41	.41	.00	1729.
1.01	2.45	33	.01	.00	.01	7.	1.01	15.15	183	.41	.41	.00	1958.
1.01	2.50	34	.01	.00	.01	8.	1.01	15.20	184	.62	.61	.01	2378.
1.01	2.55	35	.01	.00	.01	9.	1.01	15.25	185	.72	.71	.01	3001.
1.01	3.00	36	.01	.00	.01	10.	1.01	15.30	186	1.75	1.73	.01	4540.
1.01	3.05	37	.01	.00	.01	11.	1.01	15.35	187	2.88	2.86	.02	8076.
1.01	3.10	38	.01	.00	.01	12.	1.01	15.40	188	1.13	1.12	.01	10518.
1.01	3.15	39	.01	.00	.01	13.	1.01	15.45	189	.72	.72	.00	8922.
1.01	3.20	40	.01	.00	.01	14.	1.01	15.50	190	.62	.61	.00	6571.
1.01	3.25	41	.01	.00	.01	15.	1.01	15.55	191	.41	.41	.00	4687.
1.01	3.30	42	.01	.00	.01	16.	1.01	16.00	192	.41	.41	.00	3532.
1.01	3.35	43	.01	.00	.01	17.	1.01	16.05	193	.32	.31	.00	2801.
1.01	3.40	44	.01	.00	.01	18.	1.01	16.10	194	.32	.31	.00	2318.
1.01	3.45	45	.01	.00	.01	19.	1.01	16.15	195	.32	.31	.00	2042.
1.01	3.50	46	.01	.00	.01	20.	1.01	16.20	196	.32	.31	.00	1913.
1.01	3.55	47	.01	.00	.01	21.	1.01	16.25	197	.32	.31	.00	1858.
1.01	4.00	48	.01	.00	.01	21.	1.01	16.30	198	.32	.31	.00	1837.
1.01	4.05	49	.01	.00	.01	22.	1.01	16.35	199	.32	.31	.00	1828.
1.01	4.10	50	.01	.00	.01	23.	1.01	16.40	200	.32	.31	.00	1825.
1.01	4.15	51	.01	.00	.01	24.	1.01	16.45	201	.32	.31	.00	1823.
1.01	4.20	52	.01	.00	.01	25.	1.01	16.50	202	.32	.31	.00	1823.
1.01	4.25	53	.01	.00	.01	26.	1.01	16.55	203	.32	.31	.00	1823.
							1.01	17.00	204	.32	.31	.00	1824.

1.01	4.40	56	.01	.00	.01	28.	1.01	17.10	206	.25	.25	.00	1617.
1.01	4.45	57	.01	.01	.01	28.	1.01	17.15	207	.25	.25	.00	1514.
1.01	4.50	58	.01	.01	.01	29.	1.01	17.20	208	.25	.25	.00	1470.
1.01	4.55	59	.01	.01	.01	30.	1.01	17.25	209	.25	.25	.00	1450.
1.01	5.00	60	.01	.01	.01	31.	1.01	17.30	210	.25	.25	.00	1441.
1.01	5.05	61	.01	.01	.01	31.	1.01	17.35	211	.25	.25	.00	1436.
1.01	5.10	62	.01	.01	.01	32.	1.01	17.40	212	.25	.25	.00	1435.
1.01	5.15	63	.01	.01	.01	33.	1.01	17.45	213	.25	.25	.00	1434.
1.01	5.20	64	.01	.01	.01	33.	1.01	17.50	214	.25	.25	.00	1434.
1.01	5.25	65	.01	.01	.01	34.	1.01	17.55	215	.25	.25	.00	1434.
1.01	5.30	66	.01	.01	.01	34.	1.01	18.00	216	.25	.25	.00	1434.
1.01	5.35	67	.01	.01	.01	35.	1.01	18.05	217	.02	.02	.00	1220.
1.01	5.40	68	.01	.01	.01	36.	1.01	18.10	218	.02	.02	.00	1006.
1.01	5.45	69	.01	.01	.01	36.	1.01	18.15	219	.02	.02	.00	939.
1.01	5.50	70	.01	.01	.01	37.	1.01	18.20	220	.02	.02	.00	876.
1.01	5.55	71	.01	.01	.01	37.	1.01	18.25	221	.02	.02	.00	817.
1.01	6.00	72	.01	.01	.01	38.	1.01	18.30	222	.02	.02	.00	765.
1.01	6.05	73	.07	.03	.04	62.	1.01	18.35	223	.02	.02	.00	712.
1.01	6.10	74	.07	.03	.03	115.	1.01	18.40	224	.02	.02	.00	664.
1.01	6.15	75	.07	.03	.03	158.	1.01	18.45	225	.02	.02	.00	619.
1.01	6.20	76	.07	.04	.03	182.	1.01	18.50	226	.02	.02	.00	578.
1.01	6.25	77	.07	.04	.03	197.	1.01	18.55	227	.02	.02	.00	539.
1.01	6.30	78	.07	.04	.03	208.	1.01	19.00	228	.02	.02	.00	503.
1.01	6.35	79	.07	.04	.03	218.	1.01	19.05	229	.02	.02	.00	469.
1.01	6.40	80	.07	.04	.03	225.	1.01	19.10	230	.02	.02	.00	438.
1.01	6.45	81	.07	.04	.02	233.	1.01	19.15	231	.02	.02	.00	409.
1.01	6.50	82	.07	.04	.02	239.	1.01	19.20	232	.02	.02	.00	381.
1.01	6.55	83	.07	.04	.02	245.	1.01	19.25	233	.02	.02	.00	356.
1.01	7.00	84	.07	.04	.02	251.	1.01	19.30	234	.02	.02	.00	332.
1.01	7.05	85	.07	.05	.02	256.	1.01	19.35	235	.02	.02	.00	310.
1.01	7.10	86	.07	.05	.02	261.	1.01	19.40	236	.02	.02	.00	289.
1.01	7.15	87	.07	.05	.02	266.	1.01	19.45	237	.02	.02	.00	270.
1.01	7.20	88	.07	.05	.02	270.	1.01	19.50	238	.02	.02	.00	252.
1.01	7.25	89	.07	.05	.02	275.	1.01	19.55	239	.02	.02	.00	235.
1.01	7.30	90	.07	.05	.02	279.	1.01	20.00	240	.02	.02	.00	219.
1.01	7.35	91	.07	.05	.02	282.	1.01	20.05	241	.02	.02	.00	204.
1.01	7.40	92	.07	.05	.02	286.	1.01	20.10	242	.02	.02	.00	191.
1.01	7.45	93	.07	.05	.02	289.	1.01	20.15	243	.02	.02	.00	178.
1.01	7.50	94	.07	.05	.01	293.	1.01	20.20	244	.02	.02	.00	166.
1.01	7.55	95	.07	.05	.01	296.	1.01	20.25	245	.02	.02	.00	155.
1.01	8.00	96	.07	.05	.01	299.	1.01	20.30	246	.02	.02	.00	144.
1.01	8.05	97	.07	.05	.01	301.	1.01	20.35	247	.02	.02	.00	135.
1.01	8.10	98	.07	.05	.01	304.	1.01	20.40	248	.02	.02	.00	128.
1.01	8.15	99	.07	.05	.01	306.	1.01	20.45	249	.02	.02	.00	126.
1.01	8.20	100	.07	.05	.01	309.	1.01	20.50	250	.02	.02	.00	128.
1.01	8.25	101	.07	.05	.01	311.	1.01	20.55	251	.02	.02	.00	126.
1.01	8.30	102	.07	.05	.01	313.	1.01	21.00	252	.02	.02	.00	126.
1.01	8.35	103	.07	.05	.01	315.	1.01	21.05	253	.02	.02	.00	126.
1.01	8.40	104	.07	.06	.01	317.	1.01	21.10	254	.02	.02	.00	128.
1.01	8.45	105	.07	.06	.01	319.	1.01	21.15	255	.02	.02	.00	126.
1.01	8.50	106	.07	.06	.01	321.	1.01	21.20	256	.02	.02	.00	128.
1.01	8.55	107	.07	.06	.01	323.	1.01	21.25	257	.02	.02	.00	128.
1.01	9.00	108	.07	.06	.01	325.	1.01	21.30	258	.02	.02	.00	128.
1.01	9.05	109	.07	.06	.01	326.	1.01	21.35	259	.02	.02	.00	128.
1.01	9.10	110	.07	.06	.01	328.	1.01	21.40	260	.02	.02	.00	128.
1.01	9.15	111	.07	.06	.01	329.	1.01	21.45	261	.02	.02	.00	128.
							[illegible]		262	.02	.02	.00	128.

1.01	9.40	1	.07	.06	.01	336.	1.01	22.10	266	.02	.02	.00	128
1.01	9.45	117	.07	.06	.01	337.	1.01	22.15	267	.02	.02	.00	128.
1.01	9.50	118	.07	.06	.01	338.	1.01	22.20	268	.02	.02	.00	128.
1.01	9.55	119	.07	.06	.01	339.	1.01	22.25	269	.02	.02	.00	128.
1.01	10.00	120	.07	.06	.01	340.	1.01	22.30	270	.02	.02	.00	128.
1.01	10.05	121	.07	.06	.01	341.	1.01	22.35	271	.02	.02	.00	128.
1.01	10.10	122	.07	.06	.01	342.	1.01	22.40	272	.02	.02	.00	128.
1.01	10.15	123	.07	.06	.01	343.	1.01	22.45	273	.02	.02	.00	128.
1.01	10.20	124	.07	.06	.01	344.	1.01	22.50	274	.02	.02	.00	128.
1.01	10.25	125	.07	.06	.01	345.	1.01	22.55	275	.02	.02	.00	128.
1.01	10.30	126	.07	.06	.01	346.	1.01	23.00	276	.02	.02	.00	128.
1.01	10.35	127	.07	.06	.01	347.	1.01	23.05	277	.02	.02	.00	128.
1.01	10.40	128	.07	.06	.01	348.	1.01	23.10	278	.02	.02	.00	128.
1.01	10.45	129	.07	.06	.01	348.	1.01	23.15	279	.02	.02	.00	128.
1.01	10.50	130	.07	.06	.01	349.	1.01	23.20	280	.02	.02	.00	128.
1.01	10.55	131	.07	.06	.01	350.	1.01	23.25	281	.02	.02	.00	128.
1.01	11.00	132	.07	.06	.01	351.	1.01	23.30	282	.02	.02	.00	128.
1.01	11.05	133	.07	.06	.01	351.	1.01	23.35	283	.02	.02	.00	128.
1.01	11.10	134	.07	.06	.01	352.	1.01	23.40	284	.02	.02	.00	128.
1.01	11.15	135	.07	.06	.01	353.	1.01	23.45	285	.02	.02	.00	128.
1.01	11.20	136	.07	.06	.01	353.	1.01	23.50	286	.02	.02	.00	128.
1.01	11.25	137	.07	.06	.01	354.	1.01	23.55	287	.02	.02	.00	128.
1.01	11.30	138	.07	.06	.01	354.	1.02	0.00	288	.02	.02	.00	128.
1.01	11.35	139	.07	.06	.00	355.	1.02	.05	289	0.00	0.00	0.00	119.
1.01	11.40	140	.07	.06	.00	356.	1.02	.10	290	0.00	0.00	0.00	111.
1.01	11.45	141	.07	.06	.00	356.	1.02	.15	291	0.00	0.00	0.00	104.
1.01	11.50	142	.07	.06	.00	357.	1.02	.20	292	0.00	0.00	0.00	97.
1.01	11.55	143	.07	.06	.00	357.	1.02	.25	293	0.00	0.00	0.00	90.
1.01	12.00	144	.07	.06	.00	356.	1.02	.30	294	0.00	0.00	0.00	84.
1.01	12.05	145	.23	.21	.01	499.	1.02	.35	295	0.00	0.00	0.00	79.
1.01	12.10	146	.23	.21	.01	816.	1.02	.40	296	0.00	0.00	0.00	73.
1.01	12.15	147	.23	.21	.01	1047.	1.02	.45	297	0.00	0.00	0.00	69.
1.01	12.20	148	.23	.21	.01	1148.	1.02	.50	298	0.00	0.00	0.00	64.
1.01	12.25	149	.23	.21	.01	1197.	1.02	.55	299	0.00	0.00	0.00	60.
1.01	12.30	150	.23	.21	.01	1221.	1.02	1.00	300	0.00	0.00	0.00	56.
									SUM	34.48	32.27	2.18	196380.
										(875.)	(820.)	(55.)	(5560.86)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10518.	2135.	682.	654.	196340.
CMS	298.	60.	19.	19.	5560.
INCHES		26.48	33.82	33.82	33.82
MM		672.55	858.94	859.09	859.09
AC-FT		1059.	1352.	1352.	1352.
THOUS CU M		1306.	1668.	1668.	1668.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1052.	213.	68.	65.	19634.
CMS	30.	6.	2.	2.	556.
INCHES		2.65	3.38	3.38	3.38
MM		67.26	85.89	85.91	85.91
AC-FT		106.	135.	135.	135.
THOUS CU M		131.	167.	167.	167.

P *

PEAK F W AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	1	.75	1	1052.	2104.	3155.	4207.	5259.	10518.
		(1.94)	(	29.78)(	59.57)(	89.35)(	119.13)(	148.91)(	297.83)(
ROUTED TO	2	.75	1	129.	392.	947.	1774.	2557.	7093.
		(1.94)	(	3.65)(	11.11)(	26.82)(	50.23)(	72.39)(	200.86)(

1 SUMMARY OF DAM SAFETY ANALYSIS

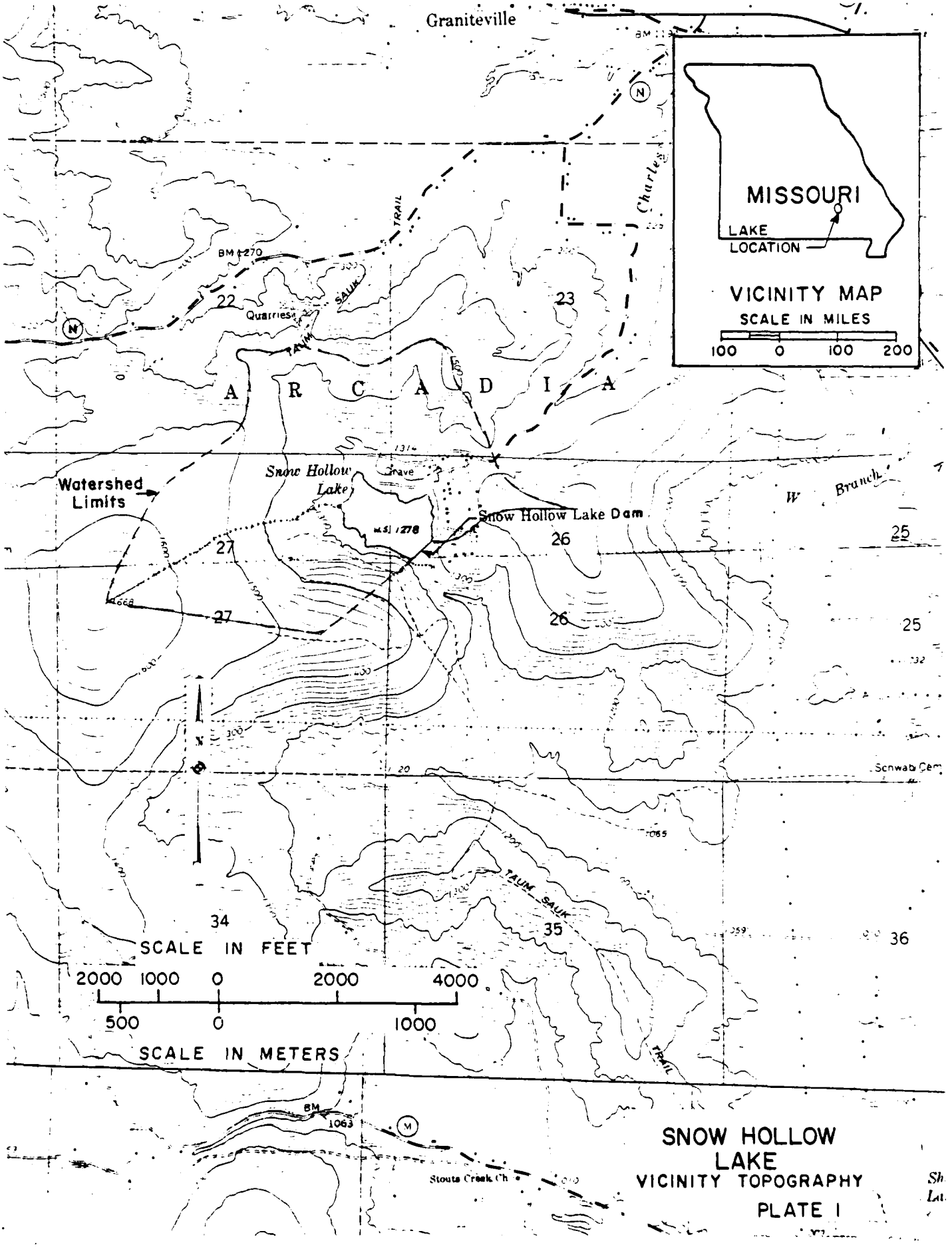
PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1278.00	1278.00	1283.40
STORAGE	0.	0.	232.
OUTFLOW	0.	0.	1589.

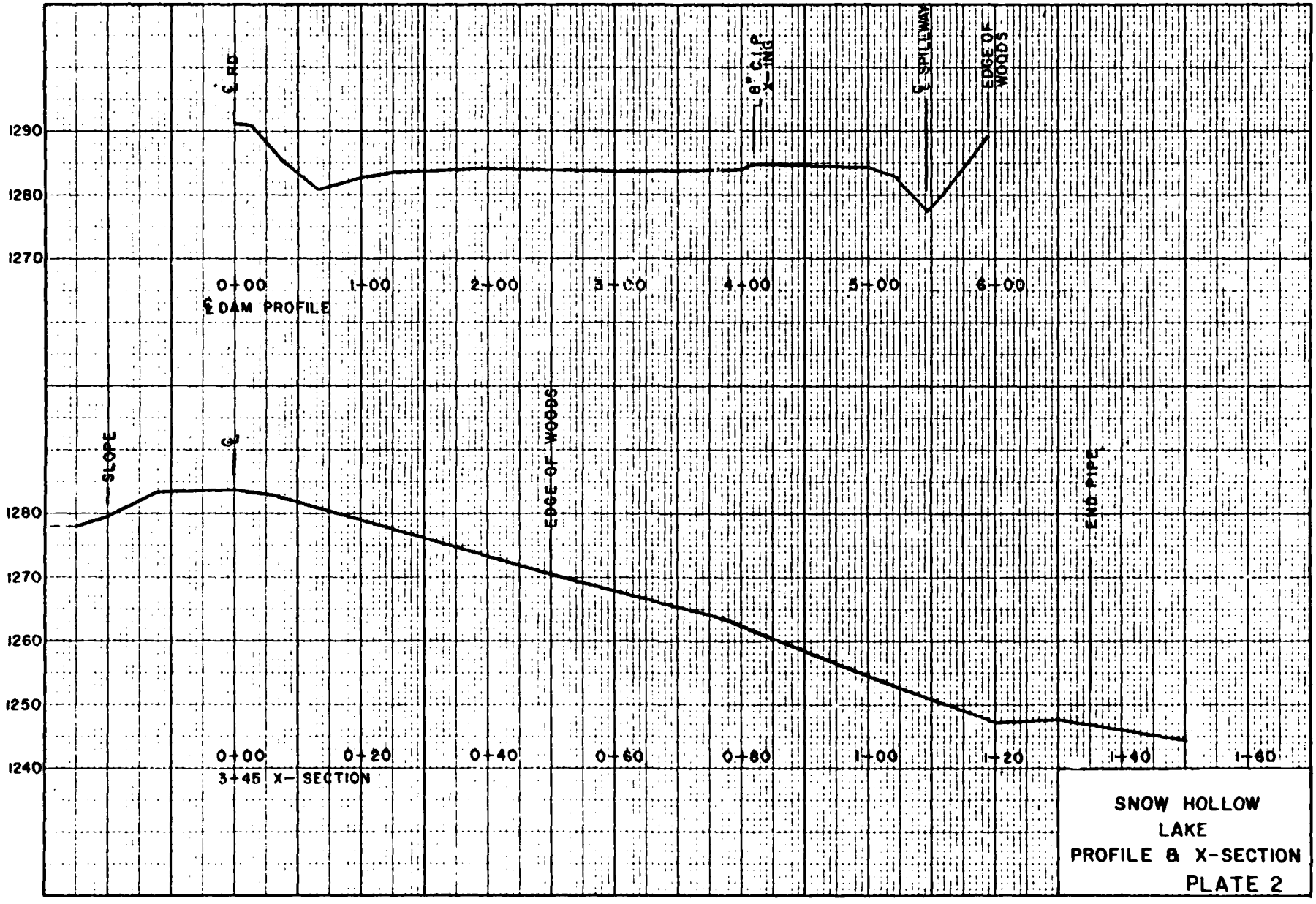
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1280.47	0.00	91.	129.	0.00	18.08	0.00
.20	1281.74	0.00	152.	392.	0.00	16.33	0.00
.30	1282.78	0.00	203.	947.	0.00	16.08	0.00
.40	1283.55	.15	239.	1774.	.33	15.92	0.00
.50	1284.13	.73	268.	2557.	.83	15.92	0.00
1.00	1285.91	2.51	354.	7093.	3.33	15.83	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

EOI.
E>Q
C>



SNOW HOLLOW LAKE
VICINITY TOPOGRAPHY
PLATE I


1290
1280
1270
℄ RD
0+00
℄ DAM PROFILE
1+00
2+00
3+00
4+00
8" C.I.P
X-ING
5+00
℄ SPILLWAY
6+00
EDGE OF
WOODS
1280
1270
1260
1250
1240
SLOPE
℄
EDGE OF WOODS
END PIPE
0+00
3+45 X- SECTION
0+20
0+40
0+60
0+80
1+00
1+20
1+40
1+60
SNOW HOLLOW
LAKE
PROFILE & X-SECTION
PLATE 2

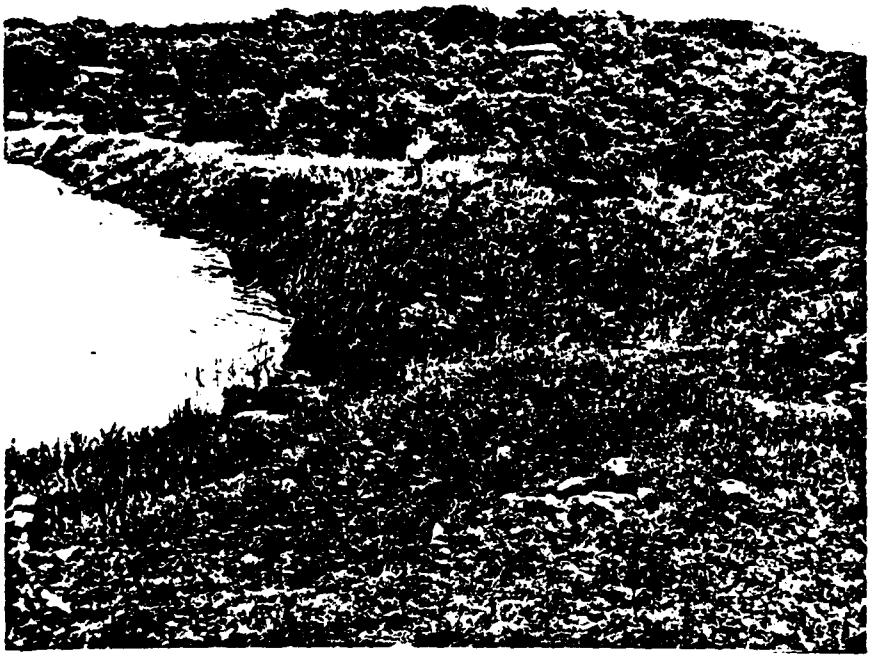


PHOTO 1: Primary Spillway - Right Abutment

PHOTO 2: Emergency Spillway - Left Abutment

PHOTO 3: Seepage at Downstream Toe of Dam

PHOTO 4: Upstream Slope of Dam

PHOTO 5: Trees and Brush on Downstream Slope

PHOTO 6: Vertical Wall of Primary Spillway

PHOTO 7: Lake Shoreline

PHOTO 8: Rock Outcroppings Around Lake

END

DATE
FILMED

11-81

DTIC